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ABSTRACT

Four observations about computers and education are offered. 1) By 1972, development of new computer systems had fallen off, and several systems developed in the mid-1960's had been terminated. The decline was particularly intense in computer-based vocational guidance systems and in computer-assisted instruction projects. The only area showing growth was computer-managed instruction. This decline is unfortunate, because computers will be essential to the education of the future. 2) A model of education in which an educator or a computer manipulates a learner's behavior will not do. A better model calls for the learner to define his own objective and then constantly refine it. 3) Some recent signs of increasing cooperation among researchers and developers include the transportability of software, regional cooperation, increased professional responsibility, and innovation in helping students actually to build computers. 4) Questions which remain to be answered include how to maintain adequate privacy against data banks, how to keep information secure, how to destroy records that are no longer useful, and how to increase cooperation among researchers in different but related areas. (JK)

ASSOCIATION FOR EDUCATIONAL DATA SYSTEMS

(New York State)

COMPUTERS AND EDUCATORS:

some observations.

Keynote Discussion at the Seventh Annual Conference
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1. A CREDIBILITY GAP ?

Not long ago, in the middle of the 1960s, hardware houses were competing with each other to support Australians wanting to study computer applications in America. Yet, in 1972, it is almost impossible to find someone in any of the major houses with enough time to talk about education. Counselling and assessment programs, especially, now appear to have a near zero priority. Why ?

A recent status report by Kroll (1972) defines a credibility gap :

> Many things have happened to dampen enthusiasm and to prevent the grand dreams from materializing. Large sums have been spent with little visible product ... early promises of vast computer capability at a cost of pennies per student-hour have vanished ... the expected boom of an "educational technology industry" has been deflated ... the United States economy has had its problems.

Kroll's explanations make sense. Could there also be other, more helpful,explanations ?

My impression* is that the only grand dreams most innovators dreamt were neither about computers nor about education. The United States Office of Education (USOE) publication describing Computer-based Vocational Guidance Systems (Scates, 1969) explored 10 computer-involved guidance systems. Of these, only David Tiedeman's "Information Systems for Vocational Decisions"(ISVD) can in any way be thought of as a grand educational dream. And a withdrawal of

* I undertook a two month study trip through U.S.A. during the autumn of 1972 to study computer applications in counselling and assessment. The trip was sponsored by the Victoria Institute of Colleges and by the Caulfield Institute of Technology.

funds caused a rude awakening even before this English-speaking computer system could be properly field tested. In all, 8 out of 10 guidance systems acknowledged by the USOE in 1969 have either been terminated, or so severly undernourished that their survival is very precarious. During the same three year period, only 2 new projects were born and show signs of being strong enough to go to school *. A very high mortality rate indeed!

The same retardation of development has affected Computer Assisted Instruction projects. A decreasing number of units originating new programs is reported in the literature (Lekan,1971). And the USOE appears to have withdrawn funds from all but 2 developments.

The only area showing growth is Computer Managed Instruction. Lippey (1972) convened a conference which attracted 23 participants of whom more than half are original developers. Low cost of the batch-processing mode for CMI suggests continuing future growth. In contrast, CVGS and CAI will be handicapped by high on-line costs, escallation of the cost of private telephone lines, increasingly complex programing and by low portability.

This is an unfortunate state of affairs.
Everyone with whom I have talked in America scknowledged that a crisis exists in education. It is not only their methods for

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* The new projects on Decision Making developed by Russell Cassel (1972) at the University of Wisconsin - Milwaukee; and Bruce McKinley's Occupational Information Access System at the University of Oregon.

which educators are held increasingly accountable, but also for the education goals themselves. The only criticism I know of Alvin Toffler's urgent prescription against Future Shock (1971), insofar as education is concerned, is that he fails to be original (Belson, 1972)! In his chapter "Education in the future tense", Toffler says:

> It is no longer sufficient for Johnny to understand the past. It is not even enough for him to understand the present, for the here-and-now environment will soon vanish. Johnny must learn to anticipate the directions and rate of change. He must, to put it technically, learn to make repeated, probabilistic, increasingly long-range assumptions about the future. And so must Johnny's teachers.

I cannot conceive of any future in which Johnny and computers will not have to live together.

2. THE HOPES OF EDUCATION

In 1926 Pressey invented a teaching machine, a mechanical device that systematized learning. Very little thought was given to the machine until 30 years later when Skinner developed a conditioning device built on behaviorist learning principles. Skinner claimed not only that his machine could manage class-room teaching as well as the teacher, but also that it had some distinct advantages (eg. no irrelevant stimuli and controlled aversive reinforcement).

Two limiting parameters have since been ascribed to computers in education.

The first of these parameters is the widely-held view that the computer can replace the educator -- be he a teacher or a counsellor. I have no doubt that the computer can relieve the educator of may routine tasks, provide self-paced drill or evaluation, perhaps even help a learner take part in An Educating Research Machine Game (Tiedeman and Miller, 1971). But to argue that the computer could replace the educator is to conjure up a feeling robot in a science fiction world.

The second parameter is a fixation at what may be called the connectionist view of learning. To move us, Robert Gagné (1970) observed:

> From an older view which held that learning is a matter of establishing connections between stimuli and responses, we are moving rapidly to acceptance of a view that stimuli are processed in quite a number of different ways by the

> human central nervous system and that understanding learning is a matter of figuring out how these various processes operate.

He continued:

> The modern point of view about learning tends to view it as a complex of processes taking place in the learner's nervous system. This view is ofter called an "information-processing" conception.

A simple mechanical model in which either an educator or a computer manipulates a learner's behaviour simply will not do. Let me explore with you a man-machine model: the metaphor of a driver in a motor car.

The notion of movement is implicit in any concept of education however we may limit the distance to be covered. The learning process is the vehicle by which the learner travels towards the educational objective. While my own preference is for the objective to be defined, and constantly refined, by the learner himself, the teaching-counselling practice contiuum covers other possibilities*. The vehicle of education then, can be a motor-car, entirely under the learner's control, or it can be a public trolley-bus which shuttles between fixed points by a given route.

I tend to change the links between the interactive components of education and the mechanical components of the vehicle each time I explore the metaphor with another person. These are some of the links at present:

* I have found the work of Lee Shulman, Professor of Educational Psychology and Medical Education, Michigan State University, especially helpful in understanding motivating strategies in edn.

The educator - the engine
Entering characteristics of the learner - the drivers skill in driving**
Evaluation - the brake system
Books and other educational resources - fuel and oil
Computer resources - ? ?

Almost 10 years ago now -- a long time in computers applications --

Cooley (1964) forshodowed a convincing parallel:

> Early automobiles had an oil pressure gauge mounted on the dash board which would continuously record the oil pressure in the motor. This little device was rather useless unless the operator knew the optimum pressure for maximum motor efficiency. Today, the human engineers have convinced car manufacturers that it is more reasonable simply to have a red light come on when the oil pressure is not what it should be, than to try to educate all American drivers to know the desired oil pressure for this particular motor.

My concern is that we are educating Johnny for driving on the super-highways of the 1970s in a T-model Ford.

** Ausubel, Shulman, Thornburg and other educationalists consider the entering characteristics of the learner to be more important than other components: a similar relationship, I think, exists between driving and the road toll.

3. SOME RECENT GAINS

The driver-and-the motorcar model may be tested for usefulness at a conference like the present NYSAEDS one. Can the authors of individual papers relate their work to the model? If they can, it may be possible to reach some consensus about learning, and about the role of resources including computers and the educators themselves. I think it more likely that educational administrators will invest money for the purchase, renting or sharing of hardware if a multiplicity of needs is likely to be met. Such a move should go some way towards obtaining access to computers for the vast majority of American learners for whom there is no meaningful access at present.

Educators are more likely to press for the use of computers when they recognize how they could be relieved of many monotonous tasks. Once free of these tasks, educators will, I hope, be responsive to inter-personal challenges: the basic role of guidance in individualization (Flanagan, 1970), motivating learners with meaningful work (Roche and MacKinnon, 1970), the self-fulfilling prophecy of teacher expectations (Brophy and Good, 1972) and social alternatives through computers (Suppes, 1971).

In the meantime, however, there are some hopeful signs of increasing cooperation among researchers and developers.

3.1 Transportability of soft-ware

To overcome the almost insurmountable obstacles caused by hardware differences, five university computer centres have been brought together by the National Science Foundation across large distances; joining Oregon, Texas and Massachusetts. They will coordinate their efforts (Blum, 1972) and pool existing resources to achieve four primary goals through the mechanism of the CONDUIT organization:(a) central cataloguing and documentation of available materials (b) national dissemination of catalogs, documents and, ultimately, the materials themselves to the academic community; (c) testing transportability of materials from one computer environment to another; (d) use of these materials in classrooms and evaluation of their effectiveness. CONDUIT is essentially a feasibility study to determine whether such materials can be successfully delivered and used and whether there is a need for a permanent resource center to operate at the national level as a clearing-house and data bank for program exchange.

3.2 Regional Cooperation

In computing, the general economic rule which favors large production systems over small ones, based on the economy of scale, has come to be known as Grosch's law.* This states that the

* The relation, stated by H.R. Grosch in the 1940's, has been disputed and rehabilitated a number of times. See Solomon, M.B.: "Economies of Scale and the IBM/360", Communications of the ACM, vol. 9, no. 6, June 1966, pp. 435-440, and Sharpe, W.F.; "The Economics of Computers", Columbia University Press, 1969, p. 315 et seq.

effectiveness of a computing system, as measured by throughput or speed, is proportional to the square of the cost. The effect of this law is that large, multifunction institutions can reduce their equipment costs, or alternatively acquire a more effective system for the same cost, by consolidating their computer service into a single facility rather than establishing separate facilities at each unit. I have come across a number of consortium arrangements in which a higher education institution cooperates with others, sometime with secondary schools districts, to develop and share common computer facilities.

3.3 Increased Professional Responsibility

Developments like the founding of the Commission on Computer Assisted Guidance Systems have led to very recent reports (Harris, 1971) designed to be of practical value to counsellors, directors of guidance programs, counselor educators, state officials, school administrators, school board members, and other personnel who find themselves in a decision-making role about the development, funding, selection, and evaluation of computer-based vocational guidance systems. This report seeks to lay guidelines for such systems so that the decision-maker may measure a system being proposed for development or offered for lease or purchase against this set of guidelines, with the end result that he will be able to make an informed decision about the quality of the system being proposed.

3.4 Innovation

Papert and Solomon (1972) recently helped primary school children to actually build computers. In their image of a computation laboratory, an important role is played by numerous "controller ports" which allow any learner to plug any device into the computer. The ports are protected by fuses and suitable interfaces so that little harm will be done if anyone carelessly puts the main voltage into a computer output port. The laboratory will have a supply of motors, solenoids, relays, sense devices of various kinds, etc. Using them, the learner will be able to invent and build an endless variety of cybernetic systems.

4. CONCLUSION

The technology of computers will not lag far behind once some consensus has been reached and a pattern of cooperation established. But as more and more use is made of data banks, adequate safeguards will be needed to protect the civil liberties of the system participants. I have found that very little work has been done in this area although there are some noteworthy exceptions like the LINK system (Astin and Boruch, 1970). I hope that NYSAEDS participants, now or in the future, will help me answer at least some of the following questions:

4.1 The privacy issue: how can individuals maintain adequate control over information about themselves?

4.2 The security issue: how can data be safeguarded against unauthorized disclosure, modification or destruction?

4.3 The relevance issue: how can records be destroyed automatically after specified target dates have been reached (eg. on completion of course)?

4.4 The cooperation issue: how can applied researchers in different areas (eg. in health and in education), who are probably solving similar problems, make contact with each other?

K.T. Wyman
2nd. October 1972

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